CLAIMS

What is claimed is:

1. A method for the detection and/or analysis of compounds which simultaneously exhibit nuclear quadrupolar resonance and nuclear magnetic resonance, said compounds bearing a spins A nuclei group capable of exhibiting a quadrupolar resonance; and a spins B nuclei group, capable of exhibiting a magnetic resonance, characterized in that said method comprises:

a) application of a first magnetic field H_1 to said spins A nuclei group, said field H_1 oscillating in the quadrupolar resonance frequency of said spins A nuclei group, and simultaneously on said spins B nuclei group, other second and third magnetic fields, said second magnetic field being a magnetic field H_0 which is turned on in coincidence with the first pulse of said oscillating magnetic field H_1; and said third magnetic field being a magnetic field H_2 oscillating within the magnetic resonance frequency of said spins B nuclei group in said magnetic field H_0;

b) turning off said second magnetic field H_0 when the signal of quadrupolar resonance from said spins A nuclei group is maximal, so that the signal-to-noise ratio of said quadrupolar signal increases, thereby decreasing the minimum volume of the compound able to be detected and/or analyzed;

c) digitalizing and summing detected signals while H_0 is off, in synchronism with excitation pulses sequence for H_1;

d) turning on again said magnetic field H_0 once the digitalization step ends;

e) repetition of steps b) to d) until the adequate signal-to-noise ratio required to detect said compound is obtained; and

f) emission of an alarm signal in the case of a positive detection or to proceed to the detection and/or analysis of the following compound should the signal be negative.

2. Method according to claim 1, characterized in that in the case of the failure to obtain an adequate signal-to-noise

ratio in stage e) as a consequence of the effective relaxation of spins A quadrupolar signal; said method comprises, following said step e), the repetition of the following steps until said adequate signal-to-noise ratio is reached:

e1) storage of said detected signals;

e2) waiting for said spins A group to relax, reaching its thermal balance with the network;

e3) new application of said first magnetic field H_1 onto said spins A nuclei group, said field H_1 oscillating at the quadrupolar resonance frequency of said spins A nuclei and simultaneously onto said spins B nuclei group, said other two second and third magnetic fields, said second magnetic field being a magnetic field H_0 which turns on in coincidence with the first pulse of said oscillating magnetic field H_1; and said third magnetic field being a magnetic field H_2 oscillating at the magnetic resonance frequency of said spins B nuclei;

e4) turning off said second magnetic field H_0 when the quadrupolar resonance signal from said spins A nuclei group is maximal, in order to increase the signal-to-noise ratio of said quadrupolar signal, thus decreasing the minimum volume of detectable and/or analyzable compound;

e5) digitalizing and summing new detected signals while H_0 is off, in synchronism with excitation pulses sequence for H_1;

e6) turning on again magnetic field H_0 once the digitalization step ends;

e7) repetition of steps e4) to e6) until the adequate signal-to-noise ratio required to detect said compound is obtained; and

e8) averaging new detected signals to those stored on step e1), forming a new group of detected signals.

3. Method according to claim 1, characterized in that said first magnetic field H1, to which said spins A nuclei group is subjected, is uniform, exhibiting a high frequency oscillation.

4. Method according to claim 1, characterized in that said second and third magnetic fields to which said spins A nuclei group are subjected are simultaneously applied and are perpendicular to each other, H_0 being uniform, weak, and while it remains on, it is sufficiently homogeneous and stable; and H_2 being uniform, exhibiting low frequency oscillation.

5. Method according to claim 4, characterized in that uniformity of said second magnetic field H_0, $\Delta H_0/H_0$, is calculated from the bandwidth of spins B resonance, $\Delta\omega$, and excitation bandwidth at low frequency $\Delta\omega_2$ defined by $H_2(t)$.

6. Method according to claim 5, characterized in that bandwidth of spins B resonance, $\Delta\omega$, is a feature of the compound to be detected and is expressed in terms of the magnetic field as $\Delta\omega=\gamma\Delta H$, wherein ΔH mainly refers to local fields sensed by protons in the molecule of the compound to be detected, γ being the gyromagnetic coupling factor.

7. Method according to claim 6, characterized in that the maximum variation of said second magnetic field $H_0, \Delta H_0$ is on the order of the dispersion on local fields ΔH or lower, and the bandwidth, $\Delta\omega_2=\gamma\Delta H_2$ complies with the maximum excitation condition, i.e. $\Delta\omega_2>\Delta\omega_0, \Delta\omega$.

8. Method according to claim 4, characterized in that time stability of said second magnetic field $H_0(t)$ is determinated provided bandwidth of said field $H_0, \Delta\omega_0$ does not exceed that range established by the bandwidth of said third magnetic field $H_2, \Delta\omega_2$ during the complete period of application thereof.

9. Method according to claim 1, characterized in that cut time of said second magnetic field H_0 is preferably from 10 to 100 μs, and more preferably about 10 μs.

10. Method according to claim 1, characterized in that said detected quadrupolar resonance signal is obtained by means of a spin-echo sequence.

11. Method according to claim 1, characterized in that said detected quadrupolar resonance signal is obtained by means of the application of a process of resonant excitation and off resonant detection (TONROF), which method consists of:

programming the frequency of a direct digital synthetizer (DDS) associated to a spectrometer on resonance status;

radiating spins A nuclei group with said first magnetic field H_1 adjusted to its resonance frequency;

at the beginning of the off period of said second magnetic field H_0, changing the frequency of said synthetizer (DDS) by means of a command pulse from a pulse programmer;

digitalizing signal by means of an analog/digital converter at a fixed frequency on the order of 10 to 100 kHz, as may be desirable; and

filtering the base and/or signal interference line noise persisting after said field is turned off, in order to increase the signal-to-noise ratio.

12. Method according to claim 11, characterized in that said resonance excitation and off resonance detection procedure (TONROF) is applied to a steady sequence of single pulses known as steady state free precession (SSFP) consisting of:

radiation of the sample with successive pulses of $\pi/2$ on the spins A nuclei groups; and

digitalization of the quadrupolar signal thereof at the intervals between pulses.

13. Method according to claim 12, characterized in that pulse of said second magnetic field H_0 begins in coincidence with each pulse of $\pi/2$ of said first magnetic field H_1 and ends at a time conveniently selected from successive pulses of $\pi/2$.

14. Method according to claim 11, characterized in that said resonant excitation and off resonance detection (TONROF) procedure is applied to a single pulse steady sequence known as strong off resonant comb (SORC), wherein quadrupolar signal is excited and detected when in off resonance status and which consists of simultaneously combining pulses of said second magnetic field H_0 at the semi-period comprising excitation pulses of said first magnetic field H_1, and half of the free evolution period between high frequency pulses, applying at the same time said third magnetic field H_2.

15. Method according to claim 11, characterized in that said resonant excitation and off resonance detection (TONROF) procedure is applied to a non-steady sequence of composite pulses known as spin lock spin echo (SLSE), which maintains the nuclear quadrupolar resonance (NQR) echo signal during an effective time T_2, higher than the decay T_2 of the pulse sequence and consisting of:

- application to the compound of a first high frequency pulse from said first magnetic field H_1 with an amplitude able of reorientate magnetization of quadrupolar nuclei at a 90° angle and a 0° phase for said direct digital synthetizer (DDS);
- when a period of time τ has elapsed, application of a new high frequency pulse, now of double duration or capable of reorienting sample 180° and 90° phase regarding that of the previous pulse so that exactly at a same period τ from the ending of said high frequency new pulse, the spin echo appears;
- repetition of the above step until n echoes are collected, and digitalize and sum same.

16. Method according to claim 1, characterized in that said third magnetic field H_2 may be pulsed in synchronism with pulses of H_0, in those cases in which a convenient insulation of the

nuclear quadrupolar resonance signal produced by spins A against interferences produced by H_2 were not possible.

17. A method for the detection and/or analysis of compounds exhibiting double nuclear quadrupolar resonance, said compounds bearing a spins A nuclei group and a spins B nuclei group, capable of quadrupolar resonance, characterized in that said method comprises the simultaneous application to said spins A nuclei group of a first oscillating magnetic field H_1 at its quadrupolar resonance frequency, and to said spins B nuclei group a second oscillating magnetic field H_2 at its quadrupolar resonance frequency.

18. Method according to claim 17, characterized in that spins B nuclei group possesses a quadrupolar coupling constant which depends from the quadrupolar spectrum of said spins B nuclei group.

19. Method according to claim 18, characterized in that said quadrupolar coupling constant is generally small.

20. Method according to claim 17, characterized in that said first magnetic field H_1 to which said spins A nuclei group is subjected is uniform and oscillates at high frequency.

21. Method according to claim 17, characterized in that said second magnetic field H_2 to which said spins B nuclei group is subjected is uniform and oscillates at high or low frequency, depending on the quadrupolar spectrum of nuclei B.

22. Method according to claim 17, characterized in that said detected quadrupolar resonance signal is obtained through a spin-echo sequence.

23. Method according to claim 17, characterized in that the detected quadrupolar resonance signal is obtained via the procedure of resonant excitation and off resonant detection (TONROF), which consists of:

programming the frequency of a direct digital synthetizer (DDS) associated to a spectrometer on resonance status;

radiating spins A nuclei group with said first magnetic field H_1 adjusted to its resonance frequency;

changing at the beginning of the detection stage the frequency of said DDS synthetizer through a command pulse from a pulse programmer in order to increase the signal-to-noise ratio; and

digitalizing signal by means of an analog/digital converter at a fixed frequency on the order of 10 to 100 kHz, as may be desirable.

24. Method according to claim 23, characterized in that said resonant excitation and off resonant detection (TONROF) is applied to a steady sequence of single pulses known as steady state free precession (SSFP) consisting of:

radiation of the sample with successive pulses of $\pi/2$ on the spins A nuclei groups; and

digitalization of the quadrupolar signal thereof at the intervals between pulses.

25. Method according to claim 23, characterized in that procedure of resonant excitation and off resonant detection (TONROF) is applied to a steady sequence of single pulses known as strong off resonant comb (SORC), wherein both quadrupolar signals are excited and detected when in off resonance status.

26. Method according to claim 23, characterized in that procedure of resonant excitation and off resonant detection (TONROF) is applied to a non-steady sequence of pulses known as spin lock spin echo (SLSE) which maintains the nuclear

quadrupolar resonance (NQR) echo signal during an effective time T_2, higher than the decay T_2 of the pulse sequence and consisting of:

- application to the compound of a first high frequency pulse from said first magnetic field H_1 with an amplitude able of reorientate magnetization of quadrupolar nuclei at a 90° angle and a 0° phase for said direct digital synthetizer (DDS);
- when a period of time τ has elapsed, application of a new high frequency pulse, now of double duration or capable of reorienting sample 180° and 90° phase regarding that of the previous pulse so that exactly at a same period τ from the ending of said high frequency new pulse, the spin echo appears;
- repetition of the above step until the collection of n echoes, and digitalization and summing thereof.

27. A sensor element for the detection and/or analysis of compounds which simultaneously exhibit nuclear quadrupolar resonance and nuclear magnetic resonance, said sensor element used with the method according to claim 1 being characterized in that said sensor element comprises;

a) a first coil generating said second magnetic field H_0

b) a second coil generating said first magnetic field which oscillates at high frequency, H_1; and

c) a third coil generating said third magnetic field which oscillates at low frequency, H_2.

28. A sensor element according to claim 27, characterized in that coil generating said magnetic field which oscillates at high frequency, H_1, is located as near as possible to the volume of the compound to be detected and/or analyzed.

29. A sensor element according to claim 27, characterized in that said first coil is internally surrounded by an internal shield.

30. A sensor element according to claim 27, characterized in that said second and third coils are located between said internal shield and tunnel free volume through which the compound to be detected and/or analyzed passes.

31. A sensor element according to claim 27, characterized in that an external shield externally surrounds said three coils.

32. A sensor element according to claim 27, characterized in that said first coil is a solenoidal coil, and said second and third coils conform a birdcage coil.

33. A sensor element according to claim 32, characterized in that said solenoidal coil exhibits variable width and pitch turns along the symmetry axis thereof.

34. A sensor element according to claim 29, characterized in that said internal and external shields are constructed from at least one metallic sheet, preferably cylindrical, with cuts of adequate geometry, one of the ends thereof being electrically grounded.

35. A sensor element according to claim 27, characterized in that said first coil is connected to a low-pass filter, in order to prevent the introduction of interferences into said second and third coils; and to a regulated circuit consisting of a proportional controller which controls current circulating through a MOSFET's chain which operation in the course of time is commanded by a field command pulse from a pulse programming circuit.

36. A sensor element according to claim 27, characterized in that electric power is supplied to said first coil through a first power supply, conveniently protected against counter-

currents preferably by means of a diode, current intensity being controlled by a magnetic field H_0 control device.

37. A sensor element according to claim 35, characterized in that said H_0 control device senses current on a resistance which is connected in parallel to said MOSFET's chain and through a proportional integrator-derivator (PID), commands a controller comprised of transistors, to deliver the appropriate command current to said MOSFET's chain.

38. A sensor element according to claim 27, characterized in that a starting circuit consisting of a pair of diodes, a capacitor, a second power supply and tiristor, provides the extra power for the connection of current to said first coil, in order to reduce connection time.

39. A sensor element according to claim 35, characterized in that a short pulse, from said pulse programming circuit, commands said tiristor by means of a controller.

40. A sensor element according to claim 39, characterized in that said short pulse occurs immediately before the field command pulse begins, connecting said capacitor to said regulated circuit and then delivering all of the accumulated energy to the capacitor, the voltage of the second power supply being regulated up to the desired magnetic field H_0 intensity.

41. A sensor element according to claim 35, characterized in that said regulated circuit may be replaced by a switch consisting of a tiristor and respective controller.

42. A sensor element according to claim 32, characterized in that said birdcage coil consists of:

a plurality of turns E connected in series by means of capacitors C_1, and in parallel by means of capacitors C_2,

multiband coupling circuits (MBC) connected in parallel to said capacitors C_1, and

coupling and filtering circuits for high and low frequency.

43. A sensor element according to claim 42, characterized in that said coupling and filtering circuits for high and low frequency excite, through excitation signals outphased 90°, high and low frequency coils positioned in quadrature and coupled to said sensor element by mutual induction.

44. A sensor element according to claim 43, characterized in that excitation 90° outphased signals means that for each pair of high frequency and low frequency induction coils, the signal arriving to one of the pair coils is 90° outphased respecting the excitation signal arriving to the other.

45. A sensor element according to claim 43, characterized in that coils in quadrature means that for each pair of high frequency and low frequency coils, one of the coils is located 90° as regards the other.

46. A sensor element according to claim 42, characterized in that said multiband coupling circuits (MBC) are made up by circuits L_3C_3 tuned with said capacitors C_1.

47. A sensor element according to claim 42, characterized in that high and low frequency currents simultaneously circulate through said plurality of turns E conforming said birdcage coil, in such a way that, should the current passing through said turns E be in the high frequencies band, capacitors C_1 short-circuit and said birdcage operates as a high-pass filter, and should the current passing through said turns E be in the low frequencies order, capacitors C_2 short-circuit and said birdcage coil operates as a low-pass filter.

48. A sensor element according to claim 32, characterized in that said birdcage coil consists of:

a plurality of turns E connected in series via capacitors C_3, and in parallel by means of capacitors C_4;

a micro-controller generating current sequential pulses at turns E of an end of said coil;

a direct non-inductive coupling and filtering circuit for low frequency, connected between said micro-controller and said turns E of said end of said coil; and

a coupling and filtering circuit for high frequency.

49. A sensor element according to claim 48, characterized in that said capacitors C_3 are calculated for said coil to tune the resonance frequency of spins A.

50. A sensor element according to claim 48, characterized in that said capacitors C_4 are calculated so as to exhibit a virtually null impedance at said spins A resonance frequency, but also high at low frequencies.

51. A sensor element according to claim 48, characterized in that said direct non-inductive coupling and filtering circuit comprises controllers, MOSFET's switches and low-pass filters.

52. A sensor element according to claim 48, characterized in that said coupling and filtering circuit for high frequency excites, through 90° outphased signals, two coils positioned in quadrature, coupled to said sensor element by mutual induction.

53. A sensor element according to claim 52, characterized in that 90° outphased excitation signals means that for each pair of high frequency induction coils, the signal arriving to one of the pair coils is 90° outphased respecting the excitation signal arriving to the other.

54. A sensor element according to claim 52, characterized in that coils in quadrature means that in said pair of high frequency induction coils, one of the coils is positioned 90° with respect to the other.

55. A sensor element according to claim 48, characterized in that when the excitation frequency of spins A nuclei group is in the range of a few Megahertz, capacitors C_3 syntonize the low-pass configured coil and capacitors C_4 are short-circuited in order to obtain said configuration.

56. A sensor element for the detection of elements which simultaneously exhibit nuclear quadrupolar resonance and nuclear magnetic resonance, said sensor element being used for the method according to claim 1, characterized in that said sensor element comprises:

a solenoidal coil that simultaneously generates said first and third oscillating magnetic fields H_1 and H_2;

Helmholtz coils or non-gradient biplanar variant thereof, which generate said second magnetic field H_0;

transmitter generating an exciter signal in order to generate said field H_1;

one pair of cross diodes connected at the outlet of said transmitter;

a balanced-unbalanced (balum) transformer connected to the outlet of said pair of cross diodes;

a high frequency coupling and filtering circuit, connected to the outlet of said balanced-unbalanced transformer;

a receiver/digitalizer set into which the signal enters through a quarter-waveguide ($\lambda/4$) connected between said pair of cross diodes and said balanced-unbalanced transformer;

a low frequency pulsed generator, synchronized to a pulse generator which generates the exciting signal for said field H_2, and

a low-pass filter connected to the outlet of said pulsed generator.

57. A sensor element according to claim 56, characterized in that said high frequency coupling and filtering circuit is tuned in a balanced mode configuration.

58. A sensor element according to claim 56, characterized in that said solenoidal coil possesses variable width and pitch turns.

59. A sensor element according to claim 56, characterized in that plane that contains longitudinal axis of said Helmholtz coils is perpendicular to the longitudinal axis of said solenoidal coil.

60. A sensor element according to claim 56, characterized in that said Helmholtz coils surround said solenoidal coil.

61. A sensor element according to claim 56, characterized in that said Helmholtz coils are connected to a low-pass filter by one of the ends thereof, in order to avoid interferences to be introduced into said solenoidal coil, and by the other end to a regulated circuit which is a proportional regulator controlling current circulating through a MOSFET's chain which action in time is commanded by a field command pulse from a pulse programming circuit.

62. A sensor element according to claim 56, characterized in that electric power is supplied to said Helmholtz coils by a first power supply, conveniently protected against countercurrents preferably by a diode, current intensity being controlled by a magnetic field H_0 control device.

63. A sensor element according to claim 62, characterized in that said magnetic field H_0 control device senses current on a resistance which is connected in parallel to said MOSFET's chain and through a proportional integrator-derivator (PID), commands a controller comprised of transistors, to deliver the appropriate command current to said MOSFET's chain.

64. A sensor element according to claim 56, characterized in that a starting circuit consisting of a pair of diodes, a capacitor, a second power supply and tiristor, provides the extra power for the connection of current to said Helmholtz coils, in order to reduce connection time.

65. A sensor element according to claim 61, characterized in that a short pulse from said pulse programming circuit commands said tiristor via a controller.

66. A sensor element according to claim 65, characterized in that said short pulse occurs immediately before the field command pulse begins, connecting said capacitor to said regulated circuit, thus delivering all the energy accumulated in said capacitor, voltage of the second power supply being regulated until the desired magnetic field H_0 intensity is achieved.

67. A sensor element according to claim 61, characterized in that said regulated circuit may be replaced by a switch consisting of a tiristor and respective controller.

68. A sensor element according to claim 56, characterized in that said high frequency coupling and filtering circuit comprises a plurality of capacitors, one of them being variable in order to allow a balanced mode configuration to tune the resonance frequency of the spins A nuclei group.

69. A sensor element according to claim 56, characterized in that said low-pass filter insulates said pulsed generator against solenoidal coil high frequencies.

70. A sensor element for the detection of compounds bearing a spins A nuclei group and a spins B nuclei group, both able to perform a quadrupolar resonance, said sensor element being used by the method according to claim 17, characterized in that it comprises a first coil generating a first high frequency oscillating magnetic field H_1 and a second coil generating a second high or low frequency oscillating magnetic field H_2, according to the quadrupolar spectrum of nuclei B; said first and second coils being located between a shield external to both and the free volume of the tunnel through which the compound to be detected/analyzed is to pass.

71. A sensor element according to claim 70, characterized in that said first and second coils conform a birdcage coil.

72. A sensor element according to claim 71, characterized in that said birdcage coil comprises:

a plurality of turns E connected in series by means of capacitors C_1, and in parallel by means of capacitors C_2, multiband coupling circuits (MBC)connected in parallel to said capacitors C_1, and high and low frequency coupling and filtering circuits.

73. A sensor element according to claim 72, characterized in that said high and low frequency coupling and filtering circuits excite, through 90° outphased signals, high and low frequency coils located in quadrature and coupled to said sensor element by mutual induction.

74. A sensor element according to claim 73, characterized in that 90° outphased excitation signals means that for each pair

of high and low frequency induction coils, the signal arriving to one of the pair coils is 90° outphased respecting the excitation signal arriving to the other.

75. A sensor element according to claim 73, characterized in that coils in quadrature means that in said pair of high and low frequency coils, one of the coils is positioned 90° with respect to the other.

76. A sensor element according to claim 72, characterized in that said multiband coupling circuits (MBC) are made up by circuits L_3C_3 tuned with said capacitors C_1.

77. A sensor element according to claim 72, characterized in that high and low frequency currents simultaneously circulate through said turns E conforming said birdcage coil, in such a way that, should the frequency of current passing through said turns E be in the high frequencies band, capacitor C_1 short-circuits with the aid of the MBC and said birdcage operates as a high-pass filter, and should the frequency of current passing through said turns E be in the low frequencies band, capacitor C_2 short-circuits and said birdcage operates as a low-pass filter.

78. A sensor element according to claim 70, characterized in that said external shield is constructed from at least one metallic sheet, preferably cylindrical, with cuts of adequate geometry, one of the ends thereof being electrically grounded.

79. A sensor element according to claim 71, characterized in that said birdcage coil comprises:

a plurality of turns E connected in series through capacitors C_3, and in parallel by means of capacitors C_4;

multiband coupling circuits (MBC) connected in parallel to said capacitors C_3;

a micro-controller generating current sequential pulses at turns E of an end of said coil;

a direct non-inductive coupling and filtering circuit connected between said micro-controller and said turns E of said end of said coil; and

a high frequency coupling and filtering circuit.

80. A sensor element according to claim 79, characterized in that said capacitors C_3 tune said coil at the spins A quadrupolar resonance frequency.

81. A sensor element according to claim 79, characterized in that said capacitors C_4 are calculated in such a way so as to exhibit a virtually null impedance at said spins B quadrupolar resonance frequency, but also high at low frequencies.

82. A sensor element according to claim 79, characterized in that said multiband coupling circuits (MBC) preferably comprise high frequency choke elements L_{ch}.

83. A sensor element according to claim 79, characterized in that said direct non-inductive coupling and filtering circuit comprises controllers, MOSFET's switches and low-pass filters.

84. A sensor element according to claim 79, characterized in that said high and low frequency coupling and filtering circuit excites, through 90° outphased signals, high frequency coils positioned in quadrature and coupled to said sensor element by mutual induction.

85. A sensor element according to claim 84, characterized in that 90° outphased excitation signals means that for the pair of high frequency induction coils, the signal arriving to one of the pair coils is 90° outphased respecting the excitation signal arriving to the other.

86. A sensor element according to claim 84, characterized in that coils in quadrature means that in said pair of high frequency induction coils, one of the coils is positioned 90° with respect to the other.

87. A sensor element for the detection of compounds bearing a spins A nuclei group and a spins B nuclei group, both able to perform quadrupolar resonance, said sensor element being used by the method according to claim 17, characterized in that it comprises:

a solenoidal coil that simultaneously generates said first and third oscillating magnetic fields H_1;

transmitter generating an exciter signal in order to generate said fields H_1 and H_2;

one pair of cross diodes connected at the outlet of said transmitter;

a balanced-unbalanced (balum) transformer connected to the outlet of said pair of cross diodes;

a coupling and filtering circuit for high frequency connected to the outlet of said balanced-unbalanced transformer;

a receiver/digitalizer set into which the signal enters through a quarter-waveguide ($\lambda/4$) connected between said pair of cross diodes and said balanced-unbalanced transformer;

a low frequency pulsed generator, tuned with a pulse generator which generates the exciting signal for said field H_2, and

a low-pass filter connected to the outlet of said pulsed generator.

88. A sensor element according to claim 87, characterized in that said solenoidal coil possesses variable width and pitch turns.

89. A sensor element according to claim 87, characterized in that said coupling and filtering circuit for high frequency consists of a plurality of capacitors, one of same being variable in order to allow a balanced mode configuration to tune the resonance frequency of the spins A nuclei group.

90. A sensor element according to claim 27, characterized in that the compound to e detected and/or analyzed is preferably a solid, amorphous or poly-crystalline substance, as for example explosives, drugs, or the like, placed in different kind of containers, particularly luggage, mail, and the like.

91. An arrangement for the detection of compounds exhibiting double nuclear quadrupolar resonance or nuclear quadrupolar resonance and nuclear magnetic resonance, characterized in that it comprises an external housing which surrounds a tunnel through which the compound to be detected and/or analyzed is introduced, through a conveyor belt which upon displacing itself passes through a sensor element according to claim 28.

92. An arrangement according to claim 91, characterized in that it is connected to a spectrometer, which is in turn connected to a control computer.

93. An arrangement according to claim 92, characterized in that said control computer controls all the detection process such as to render same automatic, collecting at the same time the nuclear quadrupolar resonance signal already digitalized and commands, via controllers, different alarm and information outputs.

94. An arrangement according to claim 93, characterized in that said alarm and information outputs comprise a silent alarm, an audio output, a display visual output, a graphic output and/or a set of lights.